

Invasive Plant Removal

SUMMARY OF INSTRUCTIONAL ACTIVITIES



🕒 Endangered Species Act - page 3

- 🕒 ▶ Students learn about the Endangered Species Act through an interactive project on the National Park Labs web site.
- ▶ Students work in groups to complete a 1200-1500 word essay about endangered species.

🕒 Plants and Culture - page 4

- 🕒 ▶ Students learn about the concept of exotic and indigenous plant species.
- ▶ Students compare the ecological role of indigenous and exotic plant species in an ecosystem, and assess the impact of removing invasive plants based on interdependencies within the system.

🕒 Milagra Ridge Introduction - page 7

- 🕒 ▶ Students visit Milagra Ridge for an introduction to the history, strategies for invasive plant removal, and techniques for seed collection.
- ▶ Students formulate questions about their experience.

🕒 Milagra Ridge Historic Timeline - page 9

- 🕒 ▶ Students work in groups to create a Milagra Ridge timeline using historic photographs.
- ▶ Students identify the factors that have contributed to the decline of endangered species at Milagra Ridge. They examine inherent values in each land use.

🕒 Mystery Plants - page 11

- 🕒 ▶ Students are introduced to the use of a dichotomous key by identifying the Mystery Plants on the National Park Labs web site.

🕒 Invasive Plant Removal - page 13

- 🕒 ▶ Students identify and remove invasive plants from a restoration site.
- ▶ Students calculate the rate of weeding for their group and use that calculation to estimate how many people-hours it will take to weed all the restoration sites in the park.
- ▶ Students discuss the contributions of volunteers in national parks.

❶ **Community Forum Role-Play:**

The Case of the Pampas Grass - page 17

- ❷ ▶ Students play the roles of community members during a planning process to decide whether or not to use herbicides on Milagra Ridge.
- ▶ Students reflect on the Environmental Justice issues addressed in the planning process and write journal entries about the role-play activity.

Exotic Plants

WHAT ARE EXOTIC PLANTS?

The National Park Service defines exotic or "non-native" species as those occurring in a given place as a result of deliberate or accidental actions by humans. Exotic plants have been introduced to North America for a variety of reasons, including livestock grazing, agriculture, forestry, ornamental landscaping, and soil stabilization.

The exchange of food plants around the world has immeasurably enriched human cultures. Potatoes, peppers, chocolate, and tomatoes, once found only in Central and South America, now thrive in gardens around the world. These species evolved on continents where their populations were kept in check by various environmental factors such as climate, disease, and herbivores. However, when they arrive in a new environment free of such ecological constraints, many become weeds along roadsides and in other disturbed areas. Some spread into natural areas, and a number of these can be classified as invasive. Exotic invasive plants dramatically reduce biodiversity by covering extensive areas so completely that other species cannot co-exist.

The spread of invasive species is one of the worst threats to biological diversity in National Parks. For example, more than 1,000 acres in Everglades National Park are lost every year to the Brazilian pepper tree and other invasive species that spread rapidly through the wildlands. Iceplant, a threat to the natural areas of California, forms thick mats in California's coastal sand dunes. Very few indigenous plants can co-exist in this iceplant monoculture. Iceplant was brought to California from South Africa more than a hundred years ago to stabilize soil and prevent sand movement across roads. Researchers have since learned its faults as a soil stabilizer and invasive weed, but too late to prevent its spread throughout coastal California.

The park targets iceplant for removal, not just because of its status as an exotic species, but because it is invasive. It is not naturally a "bad" plant. Iceplant became problematic in California due to lack of predators. Natural resource managers, needing to control the worst invasive species, remove iceplant from areas where it directly threatens endangered species habitat. Other exotic species that successfully co-exist with natives are left in place, and have become a permanent element of the California flora.

Many invasive species share biological characteristics that enable them to spread rapidly. Among these are:

- ▶ Exceptional reproductive abilities including vegetative reproduction (from stems, roots, or both), massive seed production, and extremely effective seed dispersal methods.
- ▶ Adaptation to frequent disturbance.
- ▶ Ability to survive in highly compacted or low-nutrient soils.
- ▶ Ability to produce chemicals that inhibit growth of nearby vegetation.

Endangered Species Act

SUMMARY

Students are introduced to the Endangered Species Act through an interactive project on the National Park Labs web site. They work in groups of four to complete a 1200-1500 word paper about endangered species.

TIME

6 class periods

MATERIALS

- Computers with Internet access

Lesson

Students form small groups. They access the National Park Labs web site, and go to Endangered Species Web Quest. Each of the 10 butterflies at the top is one part of the project. Several tasks are to be completed within each part.

Day One

- Students complete Part 1 and Part 2.
- Students summarize Part 3; complete Tasks 1, 2 and 3.
- Students turn in summaries and a copy of Task 2.

Day Two

- Students complete Part 3, Task 4.

Day Three

- Students complete Part 4, Tasks 1, 2, 3, and 4.

Day Four

- Students complete Part 5, Tasks 1, 2, 3, and 4.
- Students complete Part 6, Tasks 1, 2, 3, 4, and 5.

Day Five

- Students complete Part 7, Tasks 1, 2, 3, 4, and 5.
- Students complete Part 8.
- Students complete Part 9.

Day Six

- Students complete Part 10.

Plants and Culture

SUMMARY

Students learn about the concept of exotic and indigenous species. They compare the ecological roles of indigenous and exotic plant species in an ecosystem, and assess the impact of removing invasive plants based on interdependencies within the system.

TIME SCHEDULE

100 minutes

MATERIALS

- ▶ Ecosystem cards
- ▶ Plant species cards
- ▶ Invasive Plant Removal Worksheet #1

Lesson

Part 1

This activity demonstrates the concept of interdependence. Teacher assigns ecosystem "roles" to the students by handing out ecosystem cards: bumblebee, yarrow, sand, carbon, rain, wind, gopher, poppy, sun, etc. Students announce their role and whether they are a biotic (living) or abiotic (non-living) part of the ecosystem.

Teacher asks every other student in the circle to turn and face the outside. Students then become a yurt (a round, self-supporting structure) by holding hands or linking at the elbows, leaning back with their arms in front of them, and finding balance.

The yurt illustrates the delicate balance in any ecosystem.

Teacher takes the role of an invasive species, attempting to break the balance of the ecosystem by pulling the students' hands apart. Some sections stick together and others split apart, but the overall balance of the structure is broken. Students discuss the interdependence of the biotic and abiotic elements of an ecosystem, and how invasive plants affect the interdependencies. Can a yurt support itself in two or more separate pieces? How was the yurt affected when the interdependencies were broken? How is this a model of nature? How do invasive plants affect an ecosystem?

Part 2

Teacher divides the students into six groups. Each group receives a plant species card and a world map. Each group studies its card and determines if its plant should be removed from the restoration area. The group creates an argument for or against

the plant species being removed. Groups present their arguments to the class. During the presentations students show where their plant is from using the world map and dry-erase markers. Teacher notes (if students have not) that many invasive plants come from places with climates similar to California's, such as Western Australia, South Africa, western coast of Chile, and the Mediterranean.

The class discusses the following questions: How did invasive plants get to California? Is it possible for California indigenous plants to grow invasively? Under what circumstances? What do park rangers and other land managers need to know in order to make good decisions about plant removal?

Students complete Invasive Plant Removal Worksheet #1.

Invasive Plant Removal Worksheet #1



Directions: Complete the following after the Plant Species presentations.

1. What are the arguments that support the removal of plants?

2. Most exotic plants are from which countries?

3. What is the role of exotic plants in their native habitat?

4. How did invasive plants get to California?

5. Under what conditions can California native plants grow invasively?

6. What do park managers need to consider in order to make informed decisions about plant removal?

Milagra Ridge Introduction

SUMMARY

Students spend four hours on Milagra Ridge. Activities include an orientation, introduction to invasive plant removal and seed collection. The activities are structured so students can form their own opinions about values and priorities with different land uses.

TIME

4 hours

MATERIALS

- Picks
- Gloves
- Invasive Plant Removal Worksheet #2

Program

Welcome

Park staff welcome the students and facilitate a warm-up activity. A few students share questions from their journals. These questions can be used as discussion topics during the station rotations.

Stations

Students cycle through three stations with NPS staff:

- Station 1 - Orientation to Milagra Ridge and history, including biological diversity vs. monoculture.
- Station 2 - Introduction to invasive plant removal (tools and safety).
- Station 3 - Seed collection.

Students complete Invasive Plant Removal Worksheet #2 at each station.

Park staff and students clean up the stations.

Conclusion

Students gather in a large group. Students write questions in their journal. Each student shares one question with the group. Staff thank students for their work and explain the importance of volunteers working on restoration projects in Golden Gate National Recreation Area.

Invasive Plant Removal Worksheet #2



Directions: Complete the section for each station at the field session at Milagra Ridge. Formulate at least one question at the end of each station.

MILAGRA RIDGE ORIENTATION

1. How do native plant areas look different from areas where exotic plants are growing?

2. Write at least one question about the history of Milagra Ridge.

TOOLS AND SAFETY

1. What tools were used to remove plants? _____
2. Which plant species were removed? _____
3. Write at least one question about removal.

SEED COLLECTION

1. Which seed species were collected? _____
2. Write at least one question about seed collection.

● Historic Timeline

SUMMARY

Students work in groups to create a Milagra Ridge timeline with historic photographs. They identify the factors that have contributed to the decline of endangered species at Milagra Ridge. They determine values of each land use.

TIME SCHEDULE

100 minutes

MATERIALS

- ▶ Historic photographs for each land use (provided by NPS)
- ▶ Invasive Plant Removal Worksheet #3
- ▶ Poster paper
- ▶ Markers

○ Lesson

Students divide into five groups. Each group receives two photographs and the worksheet. Students study the photographs and complete the Invasive Plant Removal Worksheet #3. They identify factors that impact endangered species and determine the values that the specific land use represents.

Each group creates a poster that illustrates the value placed on the land, and the impact on the landscape as a result of the value system.

The class then discusses the common and opposing values among the posters, as well as the common and opposing impacts to the land.

Invasive Plant Removal Worksheet #3



Directions: Answer the questions below while examining the historic photographs.

1. Is there evidence of physical changes to the landscape?

YES?

Identify the evidence that indicates the physical changes to the landscape.

NO?

Identify the evidence that indicates the landscape has not changed.

How might these changes have impacted the endangered species?

What are examples in nature that can impact endangered species?

4. What are possible changes in the future that might impact endangered species?

5. What are the common values placed on the land in your photographs?

❶ Mystery Plants

SUMMARY

Students are introduced to the process of using a dichotomous key by investigating the Mystery Plant section of the National Park Labs web site.

TIME

50 minutes

MATERIALS

- Computers with Internet access
- Invasive Plant Removal Worksheet #4

❷ Lesson

Teacher explains to the students that a dichotomous key is an important tool used by biologists to identify plants. The user of a dichotomous key must answer a series of questions about the plant he/she is trying to identify. Some of the questions are easy to answer but some take knowledge of plant biology or special vocabulary. Identifying the Mystery Plants on the National Park Labs web site will help students understand how to use a dichotomous key and learn some of the terms necessary to identify plants.

Teacher distributes Invasive Plant Removal Worksheet #4. Students access the National Park Labs web site. Students complete the worksheet as they identify the Mystery Plants.

The class discusses the process of identifying plants. Include the following questions: What kinds of things need to be observed in order to identify a plant? What new terms did students learn? Students will use their observation skills and their new vocabulary when they identify which plants to remove during their next visit to Golden Gate National Recreation Area.

Invasive Plant Removal Worksheet #4



- Go to Golden Gate National Recreation Area's National Park Labs web site: www.nps.gov/goga/parklabs.
- Locate the section titled Can YOU Use a Dichotomous Plant Key?

At each step in a dichotomous key you are asked to choose between _____ for the plant you're trying to identify.



MYSTERY PLANT #1

What is a simple leaf?

What is the common name for this plant?



MYSTERY PLANT #2

What is an inflorescence?

What is the Latin name for this plant?



MYSTERY PLANT #3

What are rhizomes?

Draw a picture of this plant on the back of this page.



MYSTERY PLANT #4

What are dissected leaves?

This plant is a member of what family?



MYSTERY PLANT #5

What are pedicels? _____

In what part of the world does this plant originate?

Invasive Plant Removal

SUMMARY

Students learn to compare the ecological roles of indigenous and exotic plant species in an ecosystem, and to assess the impact of removing invasive plants based on interdependencies within the system. They use math and estimation skills to complete GGNRA Work Performed Data Sheets and to estimate the total people-hours it will take to weed an area of the park.

TIME

4 hours

MATERIALS

- Gloves ▸ Picks
- Small whiteboard & dry-erase markers
- Invasive Plant Removal Worksheet #5
- GGNRA Work Performed Data Sheet

Program

Welcome

Park staff welcome students back to the park. A few students share questions from their journals. (These questions are used as discussion topics during the station rotations.) The class discusses key concepts of invasive plants. Students offer their ideas of what these concepts mean. Park staff use the restoration cycle visual aid to illustrate how today's projects relate to other work the students will do in the park.

Stations

Students cycle through three stations. Park staff facilitates discussion about the species' native habitat, its introduction to North America, and how it threatens indigenous California ecosystems as students perform work. Students complete GGNRA Work Data Sheet, and as well as appropriate sections of Invasive Plant Removal Worksheet #5 at each station.

Conclusion

Students gather in a large group. Park staff thank the class for their hard work and explain the importance of volunteers working on restoration projects in GGNRA. Students are a part of a community of people from around the world who have contributed to habitat restoration in the park.

INVASIVE PLANT REMOVAL (THREE STATIONS)

Procedures:

- ▶ Park staff show students the boundaries of the weeding area, and an example of the invasive species to be removed. They point out any indigenous plants in the area that are endangered or especially delicate; removal of invasive species in the field is important but students must still remember to preserve the indigenous plants in the area. Students will be more likely to move carefully through plant habitat and remove invasive plants conscientiously if they have some understanding of the importance and fragility of the indigenous plants in the area.
- ▶ Before weeding, park staff give a careful safety demonstration with any tools that the group will use. Tools will be collected from any student who is using them in a way that endangers her/himself, other students, or staff. Students who are not using picks or weed wrenches safely can help weed by hand or take responsibility for bagging weeds and consolidating piles.
- ▶ During the stations, park staff facilitate a discussion. Include the following questions: What do you predict will happen in this ecosystem now that the invasive plants are removed? Can you describe the interactions between the indigenous plants and the invasive plants? (The invasive plants crowd the native plants, limit their growth and sometimes kill them.) Is it better to remove the roots of one plant or pull the top off of ten plants? (Remove the roots.) Has this species gone to seed? (If so, ensure that the seeds are being piled up with the weeds, not spread around the site.) Have you seen any of these plants before? Is this plant exotic or indigenous? What benefits does this plant have in its native habitat? Is this plant invasive? Is this plant annual or perennial?
- ▶ When weeding is complete, students discuss the importance of keeping accurate records of work that was accomplished. Students should complete the GGNRA Work Performed Data Sheet. During the last ten minutes of one of the stations, students work together on the math problem described below.

Group Math Problem: Park staff pose the following question and ask students what information they need to find the answer. As they call out the information they need (size of area weeded today, number of students weeding, etc.), a volunteer writes the information on the whiteboard. If necessary, the group can draw a diagram. Students create an equation to calculate the answer (the equation should come from the students, NOT from the park staff).

Question: You are the natural resources manager for a large park. You and your team have determined that invasive plants are severely disrupting the ecosystem of a 25-acre area of the park. You need to recruit volunteers and plan workdays to accomplish the enormous task of removing the invasive plants. Based on your experience today, how many people-hours (1 person doing 1 hour of work) do you estimate will be required to accomplish the weeding?

Sample Problem-solving Method: (Students may reach the answer in a variety of ways; park staff will let them follow their instincts.)

1. Determine the area of the site the group weeded today by multiplying the length times the width. (The students should measure the length and width with the meter wheel.) For example, if width is 40 meters and length is 30 meters, area equals 40 meters x 30 meters = 1,200 square meters.

2. Convert the area of the site from square meters into acres (4,047 square meters = 1 acre). For example, let Y equal the area of the site in acres:

$$4047 \text{ sq. meters} / 1200 \text{ sq. meters} = 1 \text{ acre} / Y \text{ acres}$$

$$4047 \times Y = 1 \times 1200$$

$$Y = 1200 / 4047$$

$$Y = .3 \text{ acre}$$

3. Calculate the number of people hours it took to weed the site today. For example, 12 students x .3 hours (20 minutes) = 4 people-hours

4. Calculate the number of people hours for the 25-acre site. It took 4 people-hours to weed .3 acres; how many people hours will it take to weed 25-acres. Let Z equal the number of people hours required to weed all 25 acres.

$$Z \text{ people-hours} / 4 \text{ people-hours} = 25 \text{ acres} / .3 \text{ acres}$$

$$Z / 4 = 83.33$$

$$Z = 83.33 \times 4$$

$$Z = 333.2 \text{ people hours}$$

Solution: 333.2 people-hours will be required to get all the weeding done. (33 volunteers who each work a little over 10 hours.)

Invasive Plant Removal Worksheet #5



Directions: Complete the section for each station at the field session at Milagra Ridge. Formulate at least one question at the end of each station.

STATION 1

1. Which plant species was the target species? _____

2. What is the total number of individual plants removed by your group? _____

3. Write at least one question about invasive plant species.

STATION 2

1. Which plant species was the target species? _____

2. What is the total number of individual plants removed by your group? _____

3. Write at least one question about plant removal techniques.

STATION 3

1. Record the length and width of the removal site. _____

2. Complete the work performed data sheet at your final station.

3. Write at least one question about the future of this site.

Community Forum Role-Play: The Case of the Pampas Grass

SUMMARY

Students participate in a debate to determine if National Park Service managers should use herbicides to eradicate invasive pampas grass on Milagra Ridge. They come to understand many different players and views, and the Environmental Justice issues that need to be resolved for successful planning. Through role-play, students work as a team to design a plan that meets the needs of a diverse community.

TIME

50 minutes

MATERIALS

- The Case of the Pampas Grass
- Invasive Plant Removal Worksheet #6
- Role cards

Lesson

Teacher reminds the students that they have been studying environmental issues in Golden Gate National Recreation Area, a national park. These environmental issues are of critical importance to nearby residents whose communities border the park. Today's activity will help them understand the complexity of open-space planning in a city environment.

A student reads aloud The Case of the Pampas Grass that describes a fictional but realistic scenario set at Milagra Ridge. The scenario involves a Town Meeting at which the participants must try to influence an important decision about the environment.

Teacher explains that the students will be asked to role-play particular members of the community with very different perspectives and needs. The class divides into small groups. Each group receives role cards representing stakeholders in the pampas grass removal project. The role cards should be distributed carefully so that each group contains students representing a variety of roles.

Students read their role card aloud to the rest of their group. Each group formulates a plan for the pampas grass removal that is acceptable to all the stakeholders in their group. If the groups have trouble moving the discussion forward, the teacher can assign any of the following responsibilities to group members: Leader, Scribe, Vote Manager, Plan Designer, and Presenter.

Student groups describe which stakeholders were represented in their groups and present their final project plan to the rest of the class. Students vote for or against the use of herbicide on Milagra Ridge.

The class discusses the following two principles of Environmental Justice and how those principles relate to urban planning:

Environmental Justice calls for universal protection from nuclear testing, and extraction, production and disposal of toxic/hazardous wastes and poisons that threaten the fundamental right to clean air, land, water, and food.

Points for discussion: Quick-fix urban ecological practices must be weighed against the possible danger of lasting toxic affects; how do we clean up and rebuild our urban parks in balance with nature?

Environmental Justice demands the right to participate as equal partners at every level of decision making, including needs assessment, planning, implementation, enforcement, and evaluation.

Points for discussion: Do all stakeholders have their voices heard? What causes some voices to be heard over others? What can be done to create more equity in the urban planning process?

Recall the Top Ten Environmental Rights lesson: How do the students' plans for Milagra Ridge support their list of Top Ten Environmental Rights?

Students complete Invasive Plant Removal Worksheet #6.

The Case of the Pampas Grass

Background Information

SCENARIO:

Pampas Grass is an invasive exotic plant species that was introduced to the United States from Western South America for horticultural purposes. It has huge grass-like seed heads. The seeds are easily dispersed through wind. Several seeds have landed at Milagra Ridge, producing strands of pampas grass. Pampas grass is a high priority invasive plant to control because its population can grow to immense proportions if uncontrolled. Pampas grass can grow as tall as 20 feet and can spread to form vast fields in which none of the indigenous Milagra Ridge plants could get enough light, water and soil to survive.

The park staff must decide how to control the pampas grass before it spreads out of control. The staff faces three options: apply herbicide, remove each plant physically, or do nothing to contain the pampas grass and use the park's limited resources for other purposes. The use of herbicide will make the removal of pampas grass much swifter. The National Park Service has called for a Town Meeting so that the public can offer opinions on the management of Milagra Ridge and whether or not to use herbicides.

The Case of the Pampas Grass

Stakeholder Role Cards

THE PLAYERS:

The Environmental Action Team

You are the Director of a small non-profit agency located in Pacifica. Although you have only four staff people and fifty members, you are well respected by the community. You oppose the herbicide solution because you feel that the city already has far too many challenges keeping the water supply clean. A contract with a local company may contribute to the economy but you feel residents should not have to sacrifice the community's health for jobs.

The Mayor's Office

You are the Representative of the Mayor's Office. From your viewpoint, the local company most likely to get the herbicide contract needs the business. You support any plan to bring jobs to the community. You also feel any environmental damage to wildlife will be minimal.

Dog Owner

You walk your dog every day in the park. There are very few parks where dogs are permitted. Dog walking provides exercise for you and your dog. You would like the park's resources used for a comfort station, benches, and trail improvements instead of for the removal of pampas grass.

Landscape Historian

You believe that the Spanish brought pampas grass here from South America. You feel that pampas grass should be left alone as a tribute to a neglected part of local history. You also would like to see some archeological work done at the site, with hopes of finding some artifacts and remnants from the Spanish period of exploration. You feel that exotic plant communities could be used as teaching tools to help people understand more about the cultures that brought the plants to the area.

UC Berkeley Ecologist

You support the park's effort to restore indigenous plant habitat. You bring your classes to Milagra Ridge because it is an important educational tool to help the public understand the significance of genetic and plant diversity and the delicate balance of nature that must be restored for the health of all living things.

The Eco Club President

You are the President of a nationwide environmental organization. You have over 150,000 members across the country and an operating budget of \$75 million. Your headquarters is in San Francisco but you live in Pacifica. You recognize the lasting dangers of using herbicides. You also want a ban on the use of pampas grass as ornamental garden plants. All Pacific residents would have to remove any pampas grass from their home landscaping. This will prevent the spread of pampas grass.

Hiker

You are the parent of three young children. Your family visits Milagra Ridge often. You enjoy the views and identifying plants along the trails. You are concerned that invasive plants are overrunning the indigenous plants.

Hiker

You love to come to Milagra Ridge for bird watching. You are aware of the affect of herbicides on birds and other wildlife.

Volunteer

You have volunteered for the National Park Service for over ten years ever since you were studying Environmental Science at San Mateo College.

Health Care Professional

As a cancer specialist, you are fiercely opposed to herbicides in any capacity. Every day at the local clinic, you see people from your community being treated for emphysema and asthma that could be avoided if they were not exposed to toxins.

Scientist with herbicide company

You work for the company that produces herbicide. From your viewpoint, the dangers of using herbicide are minimal. You believe the herbicides will wipe out the pampas grass and leave the area safe for the indigenous species.

Artist

You are an artist and teach art classes. You have been bringing students to Milagra Ridge for over fifteen years. Your favorite time of year is when the pampas grass is in bloom. The plant makes for a perfect subject for beginning artists.

Local High School Student

You are a local high school student. You came to the meeting today because you are interested in the future of your national park. You are willing to listen to all the alternatives with an open mind and then give your opinion about the use of herbicides on Milagra Ridge.

Invasive Plant Removal Worksheet #6

The Case of the Pampas Grass



1. Explain your personal point of view on The Case of the Pampas Grass.

2. How does your personal view address principles of Environmental Justice?

3. What question do you have about national park or city planning in regards to habitat restoration projects?
